EFFECT OF INFRARED RAY ON THE QUALITY OF DRIED SKIPPER

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By

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Although a greater percentage of fish is preserved throughout the world by natural air-drying, this traditional method does not yield a first-class product. Recently, L. V. Burton[1] devised a new tunnel type drier for drying shredded cod by applying infrared radiation. T. Nitta, H. Sugimoto and T. Nakai[2] have also studied on the application of infrared ray to drying of sardine and laver and showed that the efficiency of this drying method exceeds that of natural air-drying.

In the present investigation, the authors deal with the effect of infrared ray on the quality of dried skipper, with special reference to the oxidation of oil.

Procedure

Preparation of Dried Skipper

Raw materials used in this experiment were 120 fresh skipper, Cololabis saira, landed at Shiogama, Miyagi Prefecture, on October 4th, 1951. The fish were 25.3 to 29.6 cm in length and 76.1 grams in average weight per head.

They were split along the left side of the backbone from the nape to the tail and then opened so as to lie flat in one piece. Gills and viscera were removed, and the fish were washed well in fresh water. After draining for a few minutes, the fish were quartered into 4 groups. The first and second groups were laid in a shallow basket for use as salted fish. A considerable quantity of salt is spread over each layer of fish. Thus, the alternating layers of fish and salt are piled up. The amount of salt used was 200 grams to 1000 grams of the fish. After the fish have been preserved in salt for 2 days, they are taken out and washed thoroughly in clean salt water and then drained for a few minutes. On the other hand, the third and fourth groups are stored without salting in an ice-box for the same number of days.

Thereafter the first group of salted skipper and the third group of non-salted skipper respectively were tied in pairs by their tails and hung from a hook on a bar by the window of the laboratory. They were dried under natural air for 4 days. The first three days were rainy and cloudy but the last was fine, with the air temperature 6°C and the relative humidity about 72 per cent in day time. The moisture content of the natural air-dried skipper thus obtained were reduced to about 40 per cent.

The salted second group and non-salted fourth group were also tied as stated above and hung from a rack (50 cm high, 50 cm wide and 100 cm long) to which 3 infrared lamps (100 Volt-250 Watt×3) were attached to the inner wall. The distance from the lamp to the fish and the air temperature around the fish were as follows;

Distance from lamp to fish in centimeters	Air temperature around the fish in centigrades
35	40–35
40	30–25
45	25–20
50	20>

Each alternate row of salted and non-salted fish hanging at the front, middle and rear rows before the lamps were iradiated about 90 minutes under infrared ray. After 6 hours, the final products were found to contain about 40 per cent of moisture.

Finally, a part of each of the four kinds of dried skipper thus obtained respectively were sealed with carbon dioxide in cellophane bags and kept in a dark place for one month at 0 to 10°C of room temperature.

Analytical Methods for Dried Skipper Oil

The properties of oil in these dried skipper have been examined by the following procedure.

First, the external oil that diffused out on the body surface of the dried skipper was wiped away by clean absorbent cotton. The meats then were minced and ground together with anhydrous sodium sulphate and the mass was extracted with ether. At the same time, the oily absorbent cotton was treated with anhydrous sodium sulphate and ether. These ethereal extracts respectively were evaporated to dryness under the current of carbon dioxide.

In thus obtained oils, acid value, iodine value (Wijs) and Kreis test were determined. Peroxide value was also determined by the method of Lea[3].

Results and Discussion

According to the method described above, the results obtained from freshly dried skipper are shown in Table 1. To compare with them, the nature of oil from

Table 1. Chemicl properties of oil in dried skipper.

Kind of dried skipper		Commercial salted skipper dehydrated under natural air-drying	Salted skipper dehydrated under natural air-drying	Non-salted skipper dehydrated under natural air-drying	Salted skipper dehydrated under infrared -drying	Non-salted skipper dehydrated under infrared -drying
Moisture content of dried skipper in per cent		/	39.73	45.96	38.44	47.12
Oil content of dried skipper in per cent		/	15.62	13.20	13.06	14.49
External Oil diffused out on the body surface of dried skipper	Per cent in dried skipper	/	0.94	1.08	0.88	1.37
	Per cent in total oil of dried skipper	2.15	5.99	8.14	6.73	9.47
	Acid value	18.01	16.11	11.34	7.58	5.95
	Peroxide value	/	0.0518	0.0495	0.0215	0.0151
	Iodine value (wijs)	/	85.3	86.6	82.9	91.5
	Kreis test	/	+++	+++++	+++	+
Internal body oil of dried skipper	Per cent in dried skipper	/	14.68	12.12	12.18	13.12
	Per cent in total oil of dried skipper	97.85	94.01	91.86	93.27	90.53
	Acid value	14.59	9.99	10.41	4.96	4.87
	Peroxide value	0.1851	0.0214	0.0173	0.0163	0.0158
	Iodine value (wijs)	139.2	137.8	138.1	131.6	138.5
	Kreis test	+++++ +++++	++++	+++++	++	++

Table 2. Chemical characteristics of fresh skipper oil.

Acid value	Saponification value	Iodine value (Wijs)	Peroxide value
6.40	191.3	139.4	0.0053

fresh skipper is given in Table 2.

Table 1 shows that the external oil on the body surface was 0.88 to 1.37 per cent in dried skipper or 5.99 to 9.47 per cent in total oil of dried fish. This means that about 8 per cent in total fish oil diffused out on the body surface during the drying process. On the other hand, about 92 per cent in total oil remained in the internal part of the body.

The acid value and peroxide value of external oil were higher than those of internal oil, but the iodine value of both oils equally decreased. The oxidative rancidity of external oil of natural air-dried skipper was greater than in infrared -dried skipper. On the contrary, the oxidative change in internal body oil could not be seen as in the case of external oil. It is evidently found that the characteris-

Table 3. Chemical properties of oil in dried skipper after one month storage at room temperature.

Kind of dried skipper		Salted skipper dehydrated under natural air-drying	Salted skipper dehydrated under infrared-drying
Moisture content of dried skipper in per cent		36.2	35.7
Oil content of dried skipper in per cent		15.17	14.92
External Oil diffused out on the body surface of dried skipper	Per cent in dried skipper	0.69	0.70
	Per cent in total oil of dried skipper	4.55	4.66
	Acid value	19.85	15.67
	Peroxide value	0.1061	0.0644
	Iodine value (Wijs)	110.5	96.2
	Kreis test	+++++ +++++	++++
Internal body oil of dried skipper	Per cent in dried skipper	14.48	14.22
	Per cent in total oil of dried skipper	95.45	95.34
	Acid value	17.81	15.52
	Peroxide value	0.0575	0.0452
	Iodine value (Wijs)	138.5	136.9
	Kreis test	+++++ +++++	++++ ++++

tics of oil, such as acid value and peroxide value, in natural air-dried fish were also higher than those in infrared-dried fish. From the above facts, it may be seen that the quality of oil of skipper dehydrated under infrared-drying was generally superior to that of skipper dehydrated under natural air-drying. This superiority of infrared-drying is considered to be mainly due to the lack of ultraviolet ray, which chemically acts upon the oil, and to the shortening of the time of air oxidation in the drying process.

Next, the results obtained from stored dried fish in cellophane bags for one month at 0 to 10°C of room temperature are given in Table 3. The records for the non-salted fish are not given in this table, because, after one month storage, these products were inedible and covered with abundant molds and almost left to rot and were therefore discarded without any analyzing.

Table 3 shows that both the internal and external oils equally underwent appreciable oxidative change after one month storage. Moreover, it is found that the two drying methods showed no difference in the influence on the oxidation of both oils. This is considered to be due to that the moisture contents of the products are too high for safe holding as long as one month at room temperature and also to the incompleteness of substitution of carbon dioxide for oxygen in the air and to the sealing method of cellophane bags. However, unfavorable changes in the products were less than in commercial dried skipper.

The iodine value of the external oil, as mentioned above, had decreased below about 90 during the drying process, but it increased to 96.5 and 110.5 after one month storage. It may be recognized that the internal body oil of higher iodine value gradually diffused out on the body surface and mixed with the external oil of lower value in the storage.

Furthermore it is shown that the external oil has become more insoluble in ether than the internal oil in stored fish. For instance, the ratio of external to internal oil was 6.73 : 93.27 and 5.99 : 94.01 in salted skipper and 4.66 : 95.34 and 4.55 : 95.45 in the stored skipper. This phenomenon is more clearly seen in the commercial skipper as indicated in the ratio 2.15 : 97.85. It is considered with certainty that a part of the external oil has polymerized and become insoluble in ether after one month storage.

Summary

Under the conditions employed in this experiment the following results were established :

(1) About 8 per cent in total oil of dried skipper diffused out on the body surface during the drying process.

(2) The oxidation of the external oil, specially in natural air-dried skipper, was more rancid than that of the internal oil, but both oils equally underwent

appreciable oxidative change after one month storage at room temperature.
(3) In general, the quality of oil of skipper dehydrated under infrared -drying was superior to that of skipper dehydrated under natural air-drying.
(4) The superiority of the infrared-drying is considered to be due to the lack of ultraviolet ray, which chemically acts upon the oil, and to the shortening of the time of air oxidation in the process.
(5) The iodine value of the external oil had decreased below about 90 during the drying process, but it increased to 100 or more after one month storage.
(6) The external oil has become more insoluble in ether than the internal oil of stored fish.

Reference

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